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[54] **PRESS ROLLER SUPPORTED AT OPPOSITE ENDS AND AT AN INTERIOR PORTION**

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[21] Appl. No.: **568,644**

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[51] **Int. Cl.**^{6} **G03G 15/20**

[52] **U.S. Cl.** **399/331**; 399/328

[58] **Field of Search** 355/282, 285, 355/290, 295; 399/320, 328, 331, 339

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[57] **ABSTRACT**

A structure for supporting a press roller of a fixing unit is provided. The fixing unit has the press roller and a heat roller, between which a sheet is passed. The sheet is pressed against the heat roller by the press roller. The press roller has a cylinder and an elastic layer provided on the outer peripheral surface of the cylinder. Opposite ends of the cylinder are elastically supported by the first elastic support mechanisms. A shaft extending through the cylinder rotatably supports the central portion of the cylinder via a pair of bearings. Opposite ends of the shaft are elastically supported by second elastic support mechanisms. Each of the bearings is preferably spaced away from adjacent one of the first elastic support mechanisms by a distance one third to one fifth a distance between the first elastic support mechanisms.

6 Claims, 7 Drawing Sheets

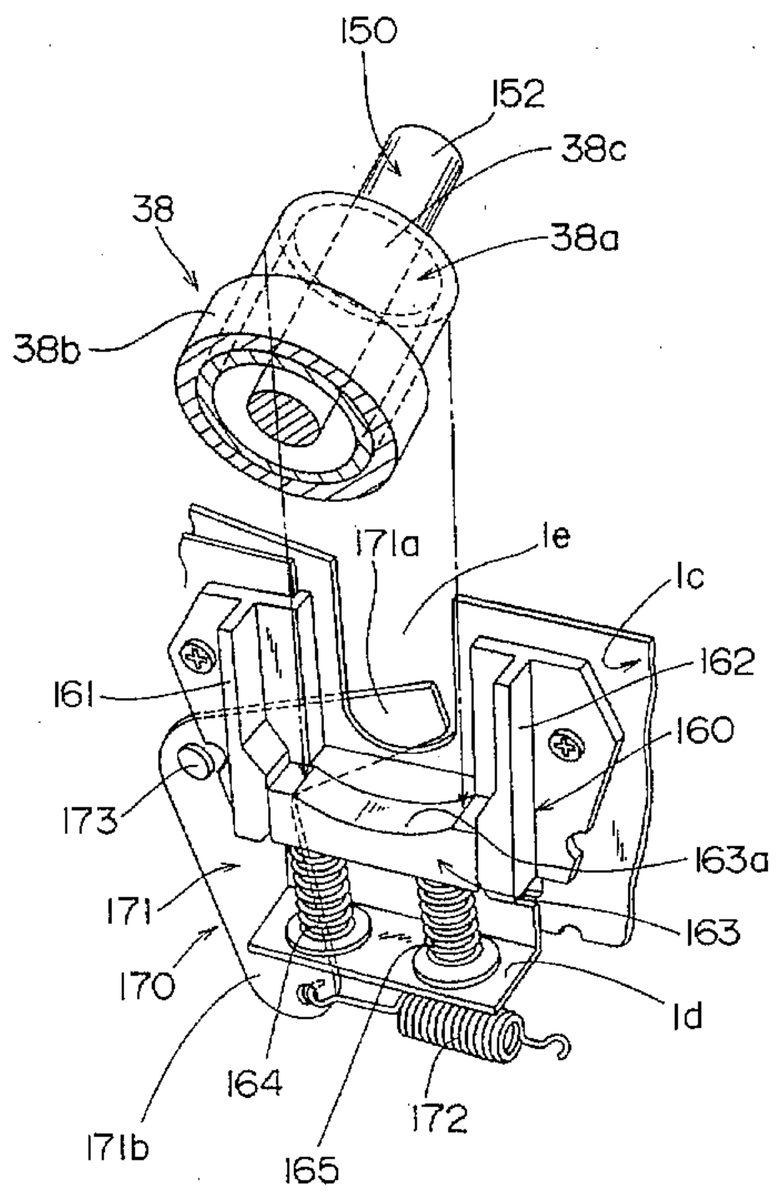


FIG. 1

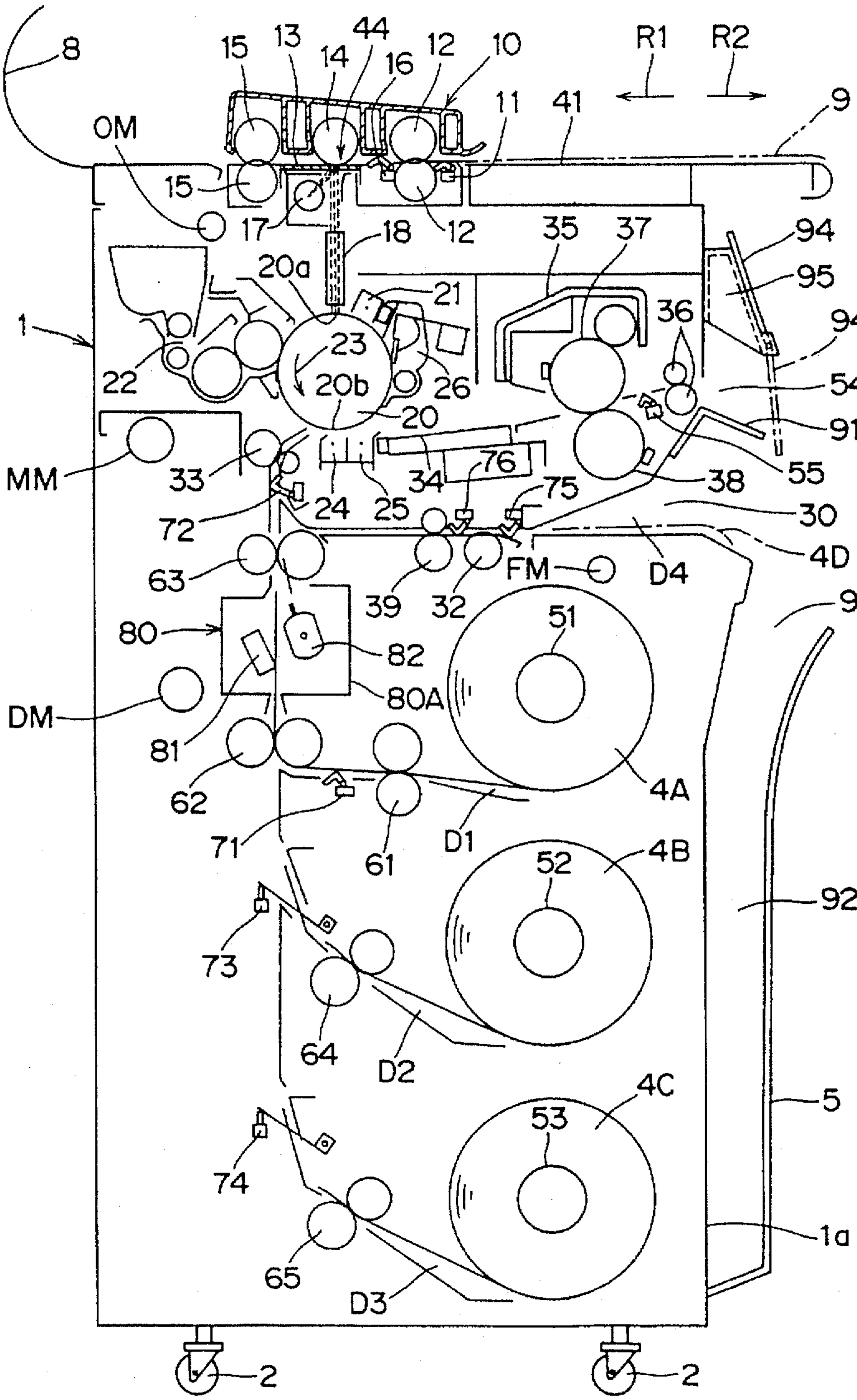

8
15
13
44
14
16
12
10
R1
R2
11
41
9
OM
15
17
18
12
35
37
94
95
20a
21
36
94
1
23
22
20b
26
54
20
91
MM
33
34
76
38
55
72
24
25
75
30
63
39
32
FM
D4
4D
93
80
82
51
80A
DM
81
62
4A
71
61
D1
52
4B
92
73
64
D2
4C
53
5
74
65
D3
1a
2
2

FIG. 2

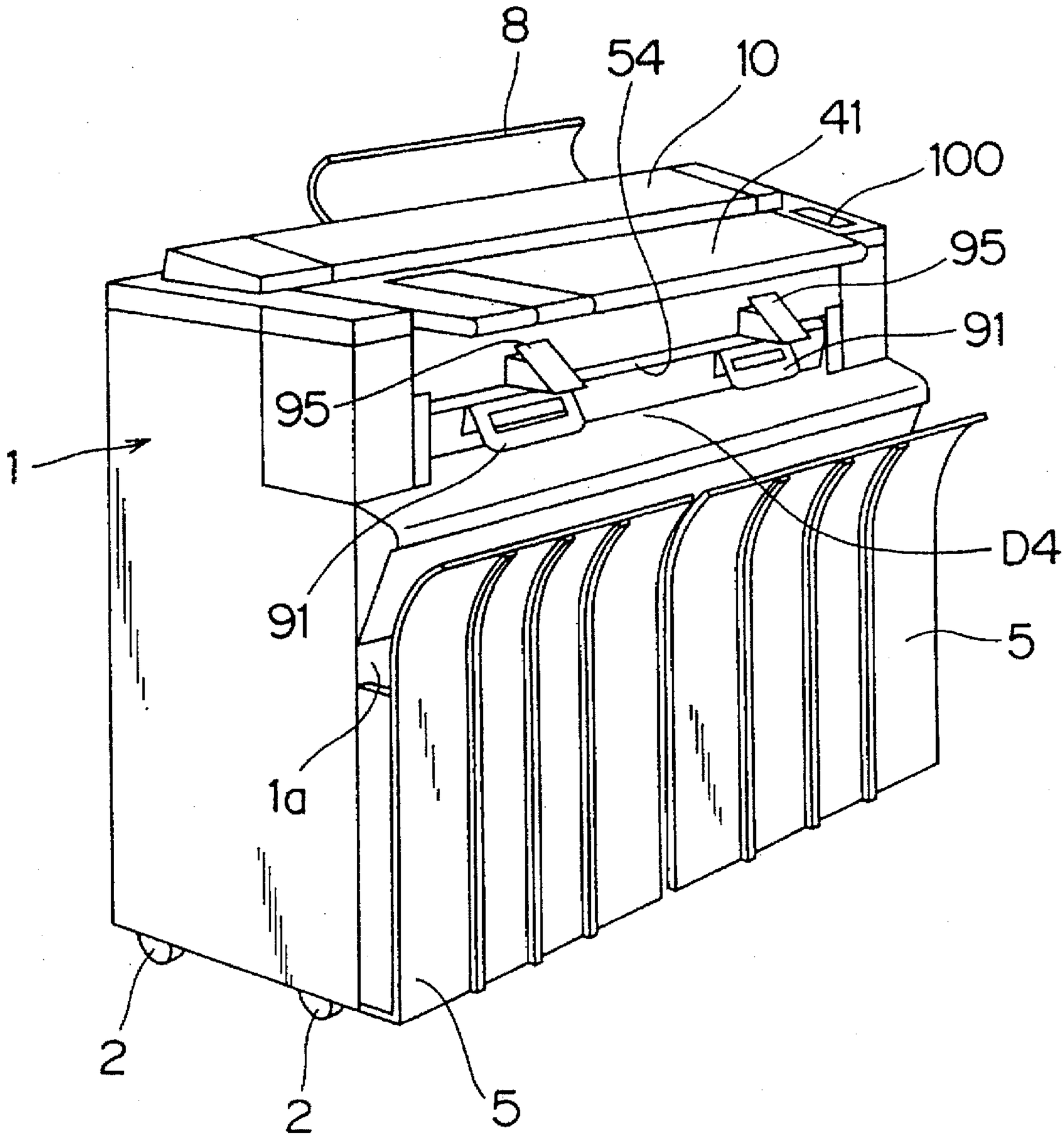


FIG. 3

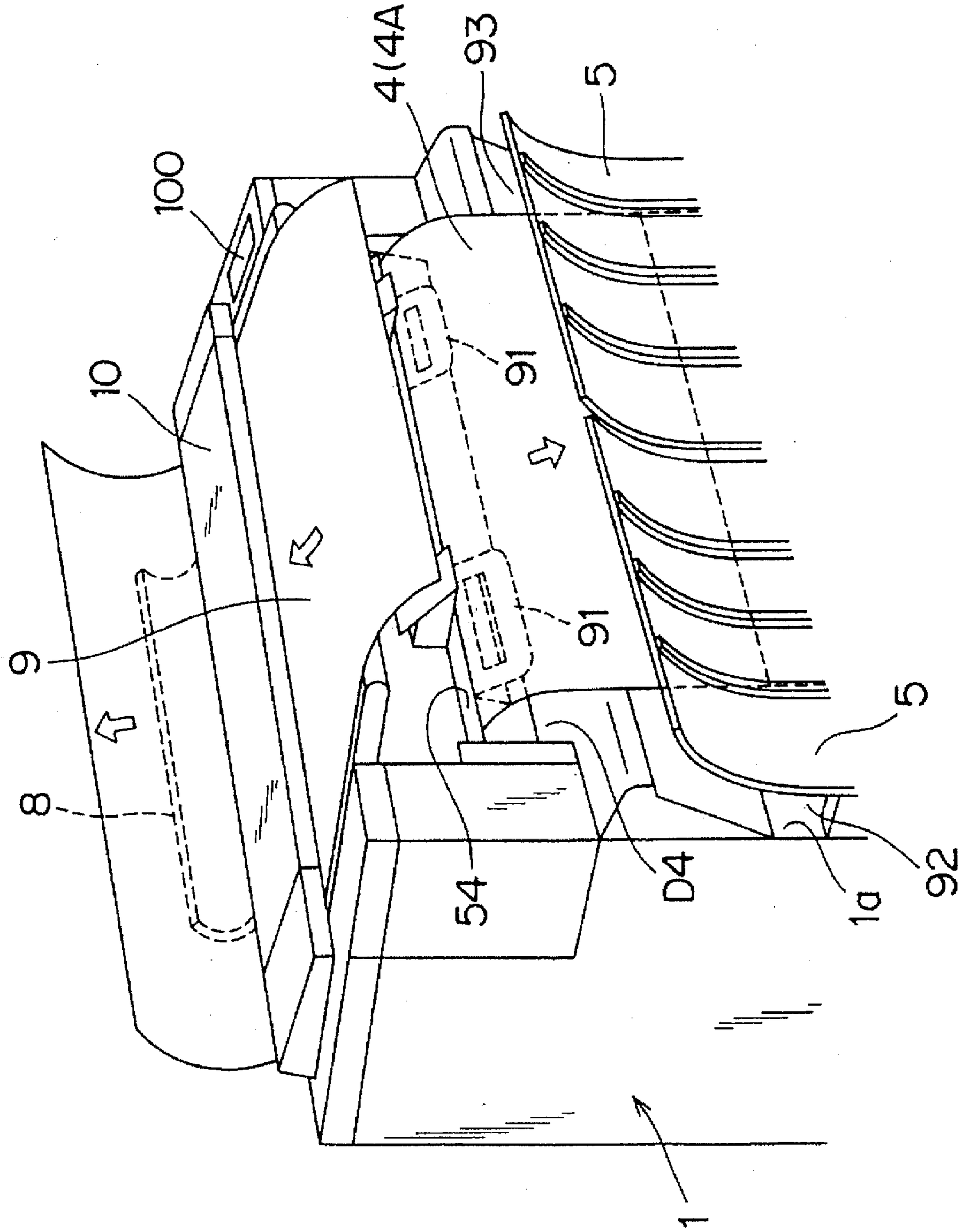


FIG. 4

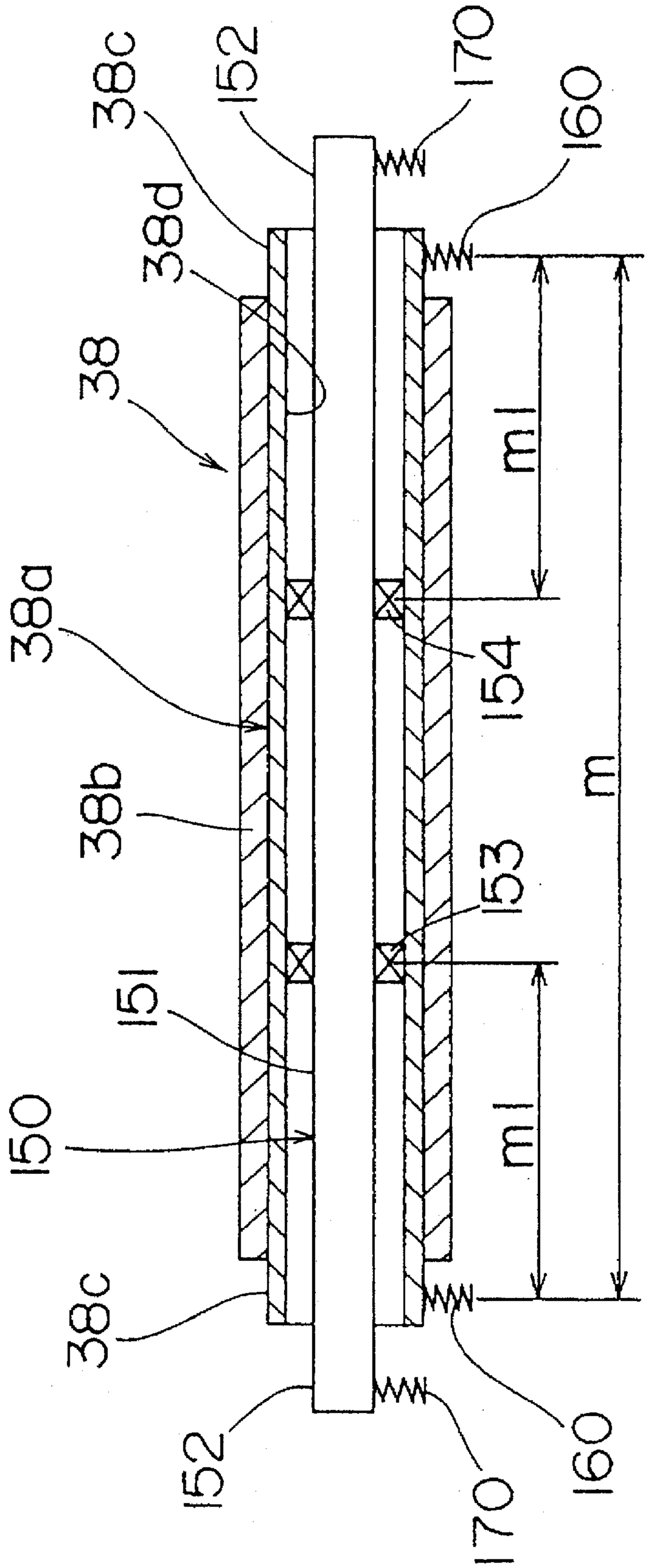

38c
152
170
160
38d
38
38d
38b
151
150
38c
152
170
160
154
153
m1
m

FIG. 5

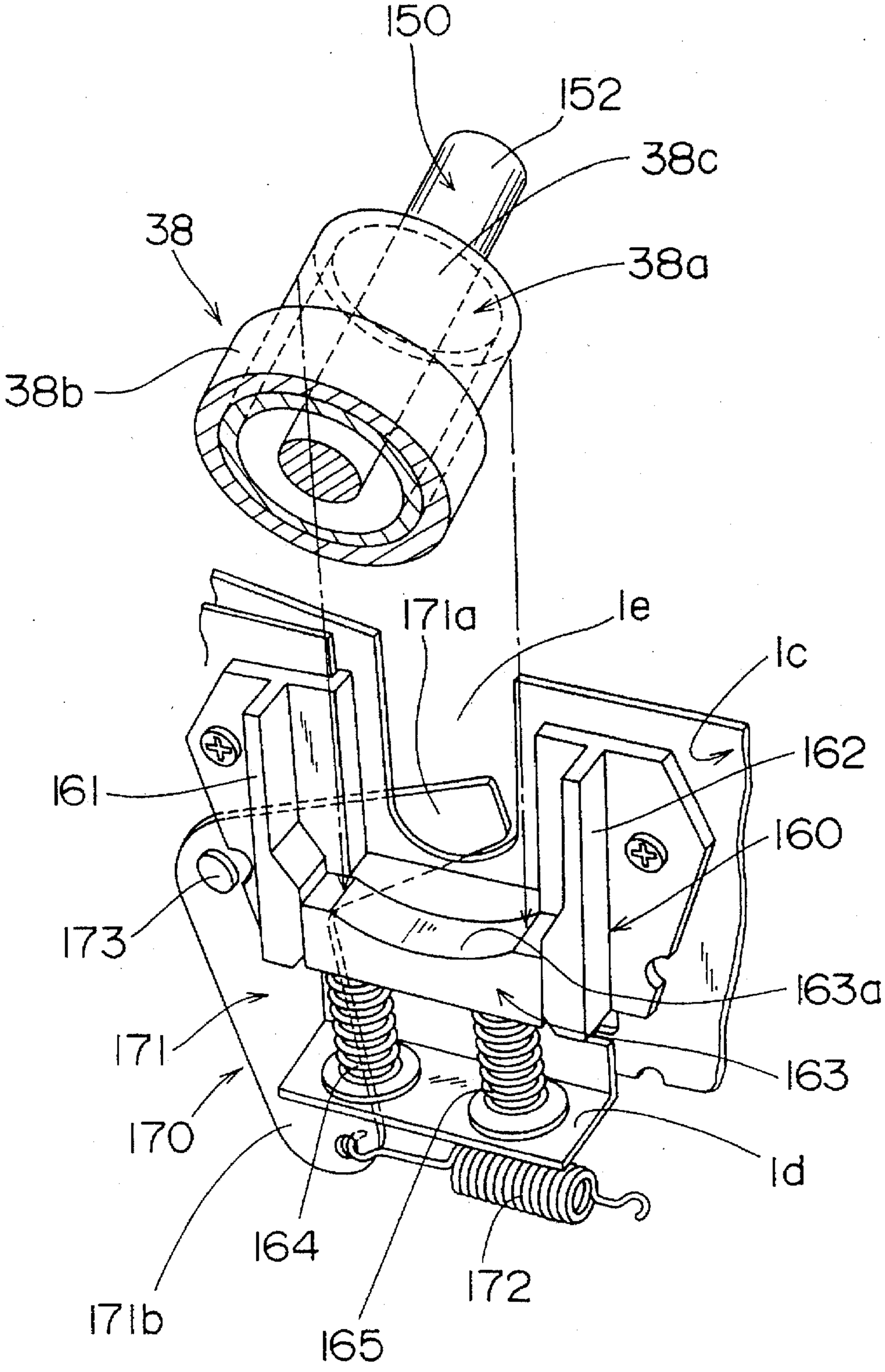

150
152
38c
38
38a
38b
171a
1e
1c
162
161
160
173
163a
171
163
170
1d
164
172
171b
165

FIG. 6

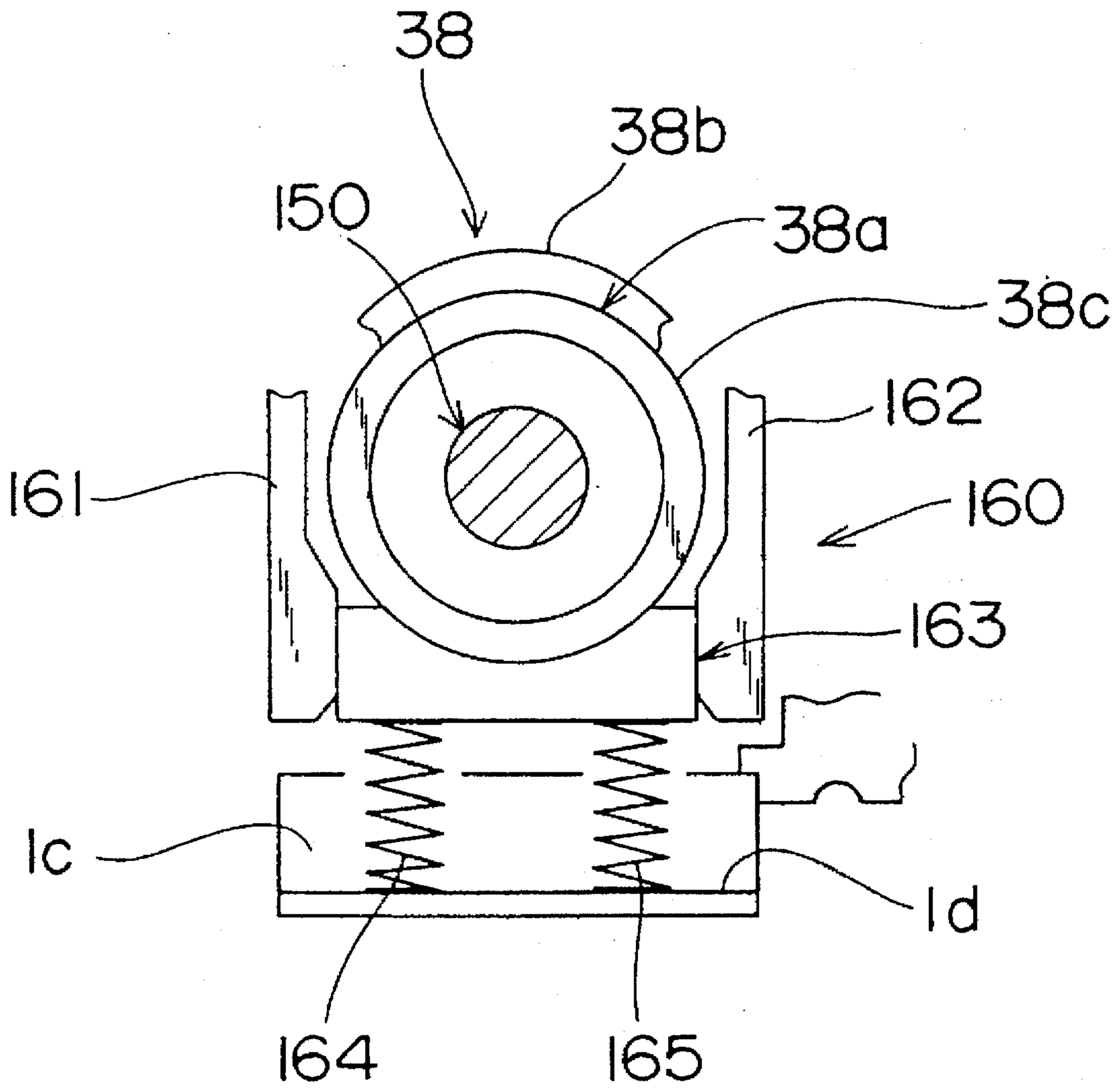
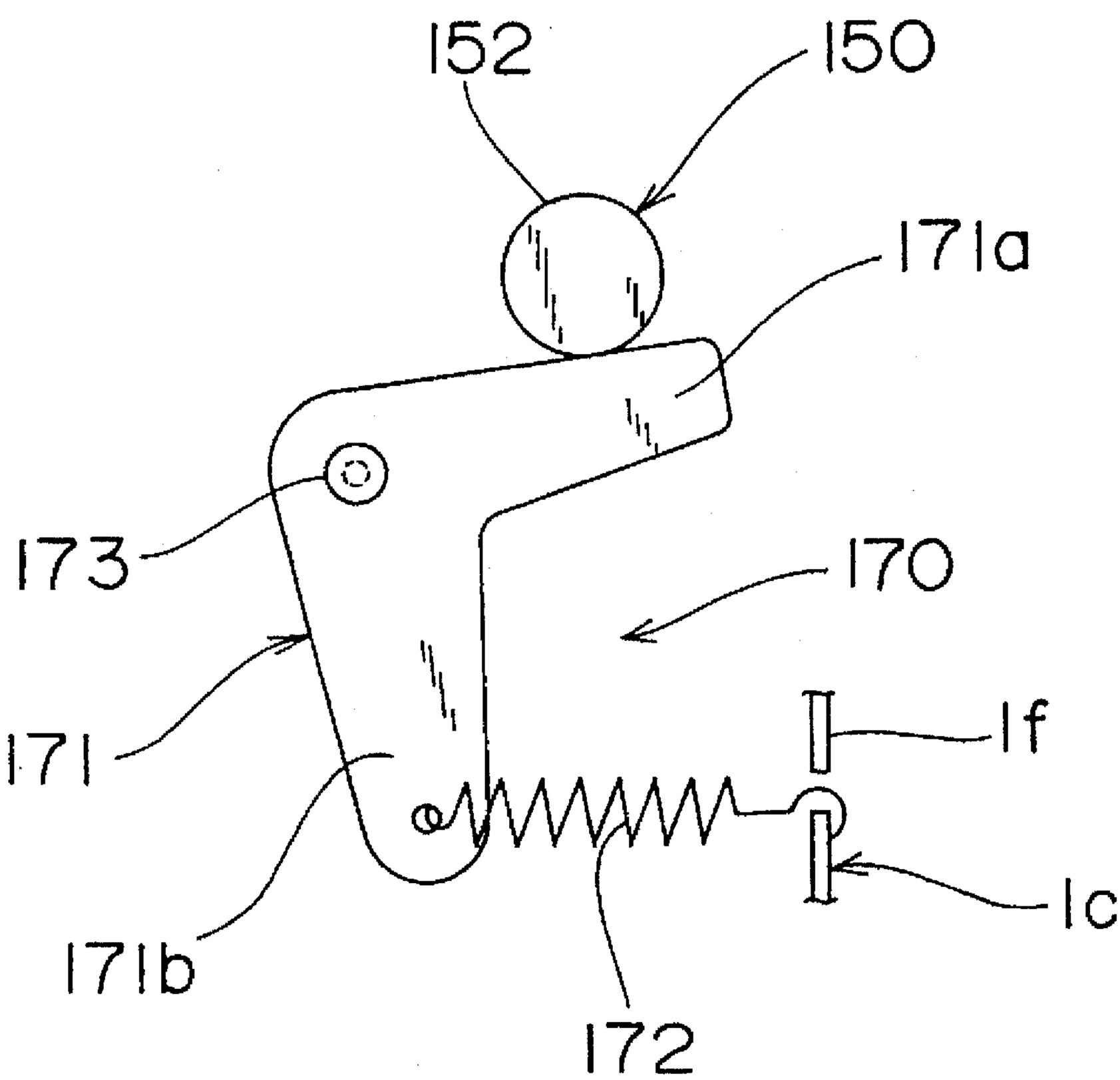


FIG. 7



PRESS ROLLER SUPPORTED AT OPPOSITE ENDS AND AT AN INTERIOR PORTION

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority benefits of Japanese patent Application No. 7-2877 (1995) under 35 USC §119, the disclosure of said Japanese patent Application being incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a press roller support structure for supporting a press roller of a fixing unit.

2. Description of Related Arts

Recently, electrostatic copying machines capable of making a copy of a large-size document original such as of JIS A0 size have become available. "JIS A0 size", which is one of the sheet sizes (finished dimensions) specified by Japanese Industrial standards, is 841 mm×1189 mm.

Since it is difficult to handle a large-size copy sheet such as of A0 size one by one, a roll sheet is generally used which is formed of an elongated continuous sheet wound around a roll core and installed in a copying machine.

In general, an electrostatic copying machine forms a copy image of a document original on a copy sheet in the following manner. The document original is scanned under light irradiation, and a photoreceptor is exposed to light reflected on the document original, whereby an electrostatic latent image is formed on the photoreceptor. The electrostatic latent image is developed into a toner image, which is then thermally fixed on a copy sheet in a fixing unit. Thus, a copy image of the document original is formed on the copy sheet.

The fixing unit has a rubber press roller and a heat roller heated by a heater and is adapted to thermally fix the toner image on the copy sheet passing between these rollers. The press roller is normally biased against the heat roller with the opposite ends thereof elastically supported by side plates.

In a copying machine adapted to copy a large-size document original, a longer-size press roll should be employed and, therefore, a longitudinally central portion of the press roll is liable to sag down. Thus, an uneven pressure is applied longitudinally to the heat roller by the press roller, resulting in biased transportation of a copy sheet passing between the press roller and the heat roller. This may cause the copy sheet to jam.

This problem is not limited to the aforesaid copying machine for copying a large-size document original, but may occur in a copying machine adapted to copy a medium- or larger-size document original which employs a relatively long press roller.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a press roller support structure which can prevent biased transportation of a copy sheet due to an uneven pressure applied to a heat roller by a press roller.

According to one aspect of the present invention, to achieve the aforesaid object, there is provided, in a fixing unit having a heat roller and a press roller brought in rotation contact with each other and adapted to pass a sheet therebetween, a press roller support structure for supporting the press roller comprising: a cylinder incorporated as part of the press roller and having an elastic layer provided on an outer peripheral surface thereof; a shaft extending through the cylinder; a bearing provided between an outer peripheral surface of the shaft and an inner surface of the cylinder for rotatably supporting a longitudinally central portion of the cylinder around the shaft; a first pair of elastic support means for rotatably and elastically supporting opposite ends of the cylinder; and a second pair of elastic support means for elastically supporting opposite ends of the shaft.

According to the above-described aspect, the cylinder is supported at the opposite ends thereof by the first pair of elastic support means, while supported at the longitudinally central portion thereof by the bearing, shaft and second pair of elastic support means. Thus, the cylinder is supported at the opposite ends thereof as well as at the longitudinally central portion thereof and, therefore, the press roller can apply an even pressure longitudinally to the heat roller. This prevents a sheet from being transported biasedly with respect to a transportation direction, thereby preventing the occurrence of jam due to the biased transportation.

According to one of the preferred modes of the press roller support structure, the bearing includes a pair of bearings, and each of the bearings is spaced away from adjacent one of the first pair of elastic support means by a distance one third to one fifth a distance between the first pair of elastic support means. Since the press roller is supported at four different points located along the press roller, the press roller can more evenly apply a pressure to the heat roller.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic sectional view illustrating the internal construction of a copying machine to which a press roller support structure in accordance with one embodiment of the present invention is applied;

FIG. **2** is a perspective view illustrating the exterior construction of the copying machine;

FIG. **3** is a perspective view illustrating the appearance of the copying machine in its operation;

FIG. **4** is a schematic sectional view illustrating the press roller support structure;

FIG. **5** is a partially exploded perspective view illustrating the press roller support structure;

FIG. **6** is a schematic side view illustrating a first elastic support mechanism; and

FIG. **7** is a schematic side view illustrating a second elastic support mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will hereinafter be described with reference to the attached drawings.

FIG. **1** is a schematic sectional view illustrating the internal construction of a copying machine in accordance with one embodiment of the present invention. FIG. **2** is a perspective view illustrating the external construction of the copying machine, and FIG. **3** is a perspective view illustrating the appearance of the copying machine which is performing a copying operation. The copying machine is adapted to obtain an image of a large-size document original such as of A0 size. In the copying machine, the document original is scanned under light irradiation by a stationary optical system while being transported, and an image is formed on the basis of the optical scanning.

Referring to FIG. **1**, a machine body i has caster wheels **2** on the under side thereof for free movement. Referring to

FIGS. 1 to 3, a document-original transportation section 10is provided on the machine body 1 for transporting a document original 9 along a document-original transportation path 41 formed on the top face of the machine body 1. A discharge port 54 for discharging a sheet having a toner image transferred thereon opens in a front face 1*a* of the machine body 1. The sheet discharged from the discharge port 54 is guided by guide members 91, dropped through a guide opening 93 with the leading edge thereof oriented downward, and accommodated in a pocket 92 defined by a front cover 5 provided along the front face 1*a* of the machine body 1, as shown in FIG. 3. On an edge portion of the top face of the machine body 1 is provided with an operation section 100 having switches, keys and the like for making various settings related to a copying operation.

Referring to FIG. 1, three roll sheets 4A, 4B and 4C which are located vertically in upper, middle and lower positions and each wound into a roll shape are accommodated within a portion between the vertically middle portion and the lower portion of the machine body 1. The roll sheets 4A, 4B and 4C are rolled around feed reels 51, 52 and 53, respectively. Examples of sheets to be used as these roll sheets 4A, 4B and 4C include normal paper, film and tracing paper. In the central portion of the machine body 1 is disposed a bypass transportation path D4 for feeding a cut-sheet preliminarily cut into a predetermined length such as of A0 size to A4 size through a manually sheet feeding section 30 provided on the front face 1*a* of the machine body 1. The roll sheet 4A in the upper position is transported along a first transportation path D1 to a photoreceptor drum 20 through the feed reel 51, sheet feeding rollers 61, a first leading-edge detection switch 71 for detecting the leading edge of the transported roll sheet 4A, transportation rollers 62, a cutter mechanism 80, transportation rollers 63, a second leading-edge detection switch 72 for detecting the leading edge of the transported sheet 4A, 4B, 4C or 4D, and transportation rollers 33 in this order. The roll sheet 4B in the middle position is transported along a second transportation path D2 to the photoreceptor drum 20 through the feed reel 52, sheet feeding rollers 64, a third leading-edge detection switch 73 for detecting the leading edge of the transported roll sheet 4B, the transportation rollers 62, the cutter mechanism 80, the transportation rollers 63, the second leading-edge detection switch 72, and the transportation rollers 33 in this order. The transportation path downstream of the transportation rollers 62 is common to the first transportation path D1.

The roll sheet 4C in the lower position is transported along a third transportation path D3 to the photoreceptor drum through the feed reel 53, sheet feeding rollers 65, a fourth leading-edge detection switch 74 for detecting the leading edge of the transported roll sheet 4C, the transportation rollers 62, the cutter mechanism 80, the transportation rollers 63, the second leading-edge detection switch 72, and the transportation rollers 33 in this order. The path downstream of the transportation rollers 62 is common to the first transportation path D1.

The bypass transportation path D4 is a path which leads the cut-sheet 4D introduced from the manually sheet feeding section 30 to the photoreceptor drum 20 through a fifth leading-edge detection switch 75 for detecting the leading edge of the transported cut-sheet, a separation roller 32 for separating cut-sheets one from another by an abut plate (not shown) abutted against the cut-sheets, a sixth leading-edge detection switch 76 for detecting the leading edge of the transported cut-sheet, resist rollers 39, the second leading-edge detection switch 72 and the transportation rollers 33 in this order. The path downstream of the second leading-edge detection switch 72 in the bypass transportation path D4 is common to the first transportation path D1.

The cutter mechanism 80 has an elongated stationary blade 81 provided in a casing 80A and extending in a direction perpendicular to a transportation direction of the roll sheet 4A, 4B or 4C, and a rotary blade 82 cooperating with the stationary blade 81 to cut the transported roll sheet 4A, 4B or 4C therebetween. The roll sheet 4A, 4B or 4C is transported upward through the cutter mechanism 80.

The document-original transportation section 10 is adapted to switch the transportation direction to either a regular direction R1 or a reverse direction R2 for the transportation of the document original 9. The image forming operation is performed when the document original is transported in the regular direction R1. When a plurality of copies are made from one document original, the document-original transportation section 10 alternates the regular transportation direction R1 and the reverse transportation direction R2 to transport the document original. The document-original transportation path 41 is provided upstream the document-original transportation section 10 with respect to the regular direction R1 on the top face of the machine body 1 and laterally projects from the top face of the machine body 1.

The document-original transportation section 10 has a first document-original edge detection switch 11, first transportation rollers 12, a second document-original edge detection switch 16, a second transportation roller 14 and third transportation rollers 15 arranged along the regular transportation direction R1 in this order.

The first transportation rollers 12 are driven in response to the detection of the leading edge (on the downstream side in the regular transportation direction R1) of the document original 9 when the first document-original edge detection switch 11 is switched on. The second transportation roller 14 facing opposite to a transparent plate 13 for exposing the document original 9 to slit light serves to press the document original 9 against the transparent plate 13. The third transportation rollers 15 serve to discharge the document original 9 after the light exposure.

The second document-original edge detection switch 16 is switched on when the document original 9 is transported therethrough in the regular transportation direction R1, thereby detecting the leading edge (with respect to the regular direction R1) of the document original 9. In response to the switch on of the second document-original edge detection switch 16, the transportation of the roll sheet 4A, 4B or 4C (hereinafter referred to simply as "roll sheet 4", the term is used to explain the copying operation) is started, thereby coordinating the transportation of the roll sheet 4 with that of document original 9.

The first document-original edge detection switch 11 is switched off after the document original 9 is transported therethrough in the regular transportation direction R1, thereby detecting the tail edge (with respect to the regular direction R1) of the document original 9. The cutter mechanism 80 is driven at a preset time point a predetermined time period after the detection of the tail edge of the document original 9 to cut the roll sheet 4. In this embodiment, the length of the transportation path extending from the cutter mechanism 80 to an image transfer position 20*b* of a corona discharger for image transfer 24 is set longer than the length of the document-original transportation path extending from the first document-original edge detection switch 11 to a document-original light-exposure position 44 by a distance between the light exposure position 20*a* of the photoreceptor

drum **20** and the image transfer position **20***b*, so that the tail edge of the sheet **4** cut at the preset time point can correspond to the tail edge of the document original **9** for image formation.

The second document-original edge detection switch **16** is switched off after the document original **9** is transported therethrough in the reverse transportation direction **R2**, thereby detecting the tail edge of the document original **9** transported in the reverse direction **R2**. In response to the switch off of the second document-original edge detection switch **16**, the driving of the transportation rollers **12**, **14** and **15** is stopped. At this time, the leading edge of the document original **9** is held between the transportation rollers **12** for the next copying operation. A reference numeral **8** denotes a reversion member for preventing the document original **9** from dropping to the rear side of the machine body **1** by reversing the transportation direction of the document original.

A stationary light source **17** for irradiating the document surface of the document original **9** is disposed in a predetermined relation with respect to the transparent plate **13**. The light from the light source **17** is emitted onto the document surface through the transparent plate **13**. The light reflected on the surface of the document original **9** is led to the surface of the photoreceptor drum **20** disposed in a generally central portion of the machine body **1** by means of a selfoc lens **18**. Before being exposed to the light from the selfoc lens **18**, the surface of the photoreceptor drum **20** is uniformly charged by a corona discharger **21** for electrostatic charging. After the light exposure, an electrostatic latent image corresponding to a document original image is formed on the surface of the photoreceptor drum **20**. The electrostatic latent image is developed into a toner image by a developing unit **22**. The toner image formed on the photoreceptor drum **20** is brought into the vicinity of the corona discharger **24** for image transfer, as the photoreceptor drum **20** is rotated in a direction indicated by the arrow **23**.

On the other hand, the sheet **4** led to the photoreceptor drum **20** from the transportation path **D1**, **D2** or **D3** is led into the vicinity of the corona discharger for image transfer **24** with being brought into contact with the surface of the photoreceptor drum **20**. Then, the toner image formed on the surface of the photoreceptor drum **20** is transferred onto the sheet **4** by way of corona discharge by the corona discharger for image transfer **24**. The sheet **4** having the toner image transferred thereon is removed from the surface of the photoreceptor drum **20** by way of corona discharge by a corona discharger **25** for sheet removal, and then led to a fixing unit **35** through a transportation path **34**. In the fixing unit **35**, toner is fixed onto the surface of the sheet **4** by heat-pressing the sheet **4** between a heat roller **37** and a press roller **38**. The sheet **4** on which the toner is fixed is discharged out of the machine body **1** through a discharge detection switch **55** and discharge rollers **36**, guided by the guide members **91**, and accommodated in the pocket **92**, as described above. After the toner image is transferred, the toner remaining on the surface of the photoreceptor drum **20** is removed by a cleaning unit **26** for the next electrostatic latent image formation. Similarly, the cut-sheet **4D** led to the photoreceptor drum **20** from the bypass sheet feeding path **D4** is subjected to the toner image transfer and the toner fixation, and then discharged into the pocket **92**.

Image forming means is constituted by such members as the photoreceptor drum **20**, the developing unit **22** and the corona discharger for image transfer **24**. In this embodiment, the copying machine further includes a main motor MM for driving the image forming means, a sheet feeding motor DM for driving the transportation rollers for feeding the sheet **4A**, **4B**, **4C** and **4D**, a fixation motor FM for driving the heat roller **37** and press roller **38** of the fixing unit **35**, and a document-original feeding motor OM for driving the document original transportation section **10**.

With reference to FIGS. **4** to **7**, there will next be described a press roller support structure for supporting the press roller **38**, which is a feature of the present invention.

Referring to FIG. **4**, the press roller **38** includes a cylinder **38***a* and a rubber layer **38***b* provided on an outer peripheral surface of the cylinder **38***a*. The rubber layer **38***b* is not provided on opposite ends **38***c* of the cylinder **38***a*. A shaft **150** extends through the cylinder **38***a*, and a pair of bearings **153** and **154** for supporting the cylinder **38***a* rotatably around the shaft **150** are provided between an outer peripheral surface **151** of the shaft **150** and an interior surface **38***d* of the cylinder **38***a*. The opposite ends **152** of the shaft **150** and the opposite ends **38***c* of the cylinder **38***a* are elastically supported by first and second elastic support mechanisms **160** and **170**, respectively, as shown in FIG. **5**. In FIG. **4**, the elastic support mechanisms are schematically shown.

Referring to FIGS. **5** and **6**, the first elastic support mechanisms **160** supporting the opposite ends **38***c* of the cylinder **38***a* each include: (1) a pair of guide members **161** and **162** fixed to a side plate **1***c* of the machine body **1**; (2) a cylinder receiving member **163** for receiving the corresponding end **38***c* of the cylinder **38***a* to be guided by the guide members **161** and **162** for vertical movement; and (3) a pair of compression coil springs **164** and **165** provided between the cylinder receiving member **163** and a step **1***d* formed by bending part of the side plate **1***c* for elastically biasing the cylinder receiving member **163** upward.

An upper face of the cylinder receiving member **163** is formed into a concavely curved surface **163***a* having substantially the same radius of curvature as that of the outer peripheral surface of the cylinder **38***a* to receive the cylinder **38***a*.

Referring to FIGS. **5** and **7**, the second elastic support mechanisms **170** supporting the ends **152** of the shaft **150** each include: (1) a shaft receiving member **171** for receiving the corresponding end **152** of the shaft **150** introduced into a recess **1***e* formed in the side plate **1***c* to be rotatably supported by the side plate **1***c*; and (2) a tension coil spring **172** for elastically and rotatably biasing the shaft receiving member **171** to allow the shaft receiving member **171** to push up the end **152** of the shaft **150**.

The shaft receiving member **171** is a V-shaped plate having a first portion **171***a* abutting against the shaft **150** and a second portion **171***b* to which one end of the tension coil spring **172** is hooked, and rotatably supported on the side plate **1***c* by a pin **173** extending through a junction of the first portion **171***a* and the second portion **171***b*.

As shown in FIG. **7**, the other end of the tension coil spring **172** is hooked to a portion if formed by bending part of the side plate **1***c*.

In this embodiment, as shown in FIG. **4**, the second elastic support mechanisms **170** supporting the opposite ends **152** of the shaft **150** support the cylinder **38***a* via the bearings **153** and **154** at two positions which generally equidistantly divide the length of the cylinder **38***a* into three (or at two positions located with the longitudinally central position of the cylinder **38***a* interposed therebetween). On the other hand, the first elastic support mechanisms **160** support the opposite ends of the cylinder **38***a*. Thus, the elongated press roller **38** can apply a generally even pressure longitudinally to the heat roller **37**. Accordingly, the biased transportation

of the roll sheet **4** can be assuredly prevented which would occur due to an uneven pressure applied to the heat roller, whereby the occurrence of jam due to the biased transportation can be assuredly prevented.

Referring to FIG. **4**, a ratio me/m of a distance me between each first elastic support mechanism **160** and adjacent bearing **153** or **154** to a distance m between the first elastic support mechanisms **160** is preferably ⅓ to ⅕ to allow the press roller **38** to more evenly apply a pressure to the heat roller **37**. Though this embodiment employs two bearings, only one bearing may be provided at the longitudinally central position of the cylinder **38**, or three or more bearings may be provided along the cylinder **38***a*. It should be understood that various modifications may be made without departing from the spirit and scope of the present invention, as defined in the appended claims.

What is claimed is:

1. A press roller support structure for supporting the press roller of a fixing unit for fixing a toner image on a sheet, the press roller being rotatably in contact with a heat roller of the fixing unit and pressing the sheet to the heat roller, the structure comprising:

a cylinder incorporated as part of the press roller and having an elastic layer provided on an outer peripheral surface thereof;

a shaft extending through the cylinder;

a bearing provided between an outer peripheral surface of the shaft and an inner surface of the cylinder for rotatably supporting a longitudinally central portion of the cylinder around the shaft;

a first pair of elastic support means for rotatably and elastically supporting opposite ends of the cylinder; and

a second pair of elastic support means for elastically supporting opposite ends of the shaft.

2. A press roller support structure as set forth in claim **1**, wherein the bearing includes a pair of bearings, each of the bearings being spaced away from an adjacent one of the first pair of elastic support means by a distance one third to one fifth a distance between each of the first pair of elastic support means.

3. A press roller support structure as set forth in claim **1**, wherein the first pair of elastic support means each include a cylinder receiving member for receiving an end of the cylinder, and a biasing member for elastically biasing the cylinder receiving member upward.

4. A press roller support structure as set forth in claim **3**, wherein the cylinder receiving member includes a receiving surface, having substantially the same radius of curvature as that of the outer peripheral surface of the cylinder, for receiving the cylinder.

5. A press roller support structure as set forth in claim **1**, wherein the second pair of elastic support means each include a shaft receiving member rotatably supported by a side plate for receiving an end of the shaft, and a biasing member for biasing the shaft receiving member in one rotational direction to allow the shaft receiving member to lift up the shaft.

6. A press roller support structure as set forth in claim **5**, wherein the shaft receiving member has a first portion at an angle with a second portion, the first portion supporting the shaft, the second portion being biased by the biasing member.

* * * * *